

Improvement of the Advanced Environmental Transfer and Dose Assessment Model for Radionuclides Released from the Nuclear Fuel Reprocessing Plant in Rokkasho

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Abstract

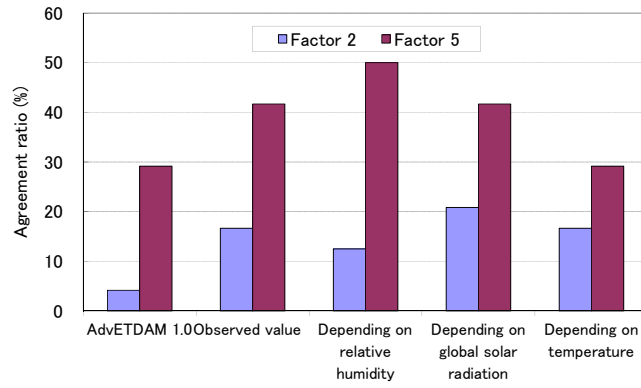
We have developed the advanced environmental transfer and dose assessment model (AdvETDAM 1.0) for radionuclides released from the first Japanese commercial nuclear fuel reprocessing plant located in Rokkasho. The computer code system was developed on a PC to describe atmospheric dispersion, terrestrial and aquatic transfers, and dose calculations for the released radionuclides. The model consists of an atmospheric dispersion model with a meteorological model (MM5), a terrestrial transfer model, an aquatic transfer model in Lake Obuchi, which is a brackish lake neighboring the reprocessing plant, and its catchment area and a coastal marine model for the Rokkasho coast.

To improve accuracy of the AdvETDAM 1.0, during FYs 2011 – 2012 we are planning to develop submodels that describe (1) dispersion of radioiodine in different physical forms in the atmosphere, (2) snow accumulation and melting on the ground, and (3) weathering of the radionuclides from leaf surface of crop plants by rainfall. Since ^3H discharged from the reprocessing plant into the Pacific Ocean was detected in Lake Takahoko, which is another brackish lake near the reprocessing plant, an aquatic transfer model in the lake and its catchment area will be developed during FYs 2013-2015. A sensitivity analysis routine of parameters will be also installed into the AdvETDAM by FY 2015.

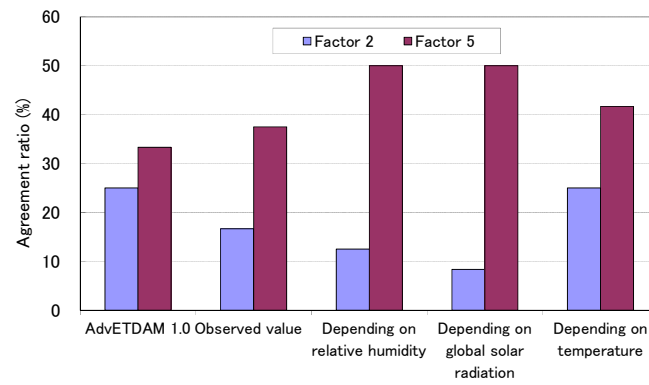
In FY 2011, the first submodel to describe atmospheric dispersion of radioiodine was developed, because ^{129}I concentrations estimated by the AdvETDAM 1.0 did not agree well with measurement results. In that submodel, gaseous radioiodine and particulate radioiodine in the atmosphere were separately treated, and deposited at different velocities for each form. The AdvETDAM 1.1 was made by installing the submodel into the AdvETDAM 1.0. We separately measured gaseous and particulate ^{129}I concentrations in the atmosphere at IES, while the discharge rate from the main stack of the reprocessing plant was given as a total of gaseous and particulate ^{129}I . The proportion of gaseous ^{129}I at the main stack was estimated by repeated calculation of the atmospheric dispersion to minimize the difference between the calculated and measured proportion. Although the atmospheric ^{129}I concentrations calculated with the estimated proportion had better agreement with the measured ones than those obtained by the AdvETDAM 1.0, the agreement in the ^{129}I deposition values was somewhat deteriorated. Since the gaseous proportion of ^{129}I in the atmosphere depends on climate conditions (air temperature, humidity and solar radiation), a sub-program for estimate the proportion from the climate conditions was installed.

In order to evaluate environmental transfer of ^3H including snow accumulation and melting, the Noah Land-Surface model and the Soil and Water Assessment Tool were selected for examination. We will choose the better one from the comparative calculations with measured results and install it into the AdvETDAM 1.1.

We collected the basic hydrological data of Lake Takahoko and its catchment area for model construction, including the bathymetry and water quality (salinity etc.) of the lake, and geological setting, hydraulic conductivity of geological samples, groundwater level and river water flow rate in the catchment area.



(1) Atmospheric concentration



(2) Deposition

Fig. 1 The calculation results of ^{129}I using the ratio of the gaseous form which changes depending on climate conditions.

Calculation conditions with AdvETDAM:

calculation area, 50 x 50 km with a grid

resolution of 500 x 500 m; 2,400 m above

ground with 26 vertical intervals varying from 10

m to 175 m; calculation period, from Apr. 2006

to Dec. 2008.